WHAT IS CLAIMED IS:

1. A method (Fig. 5A) for creating a pixel image $\hat{f}$ from projections $(q_1 \ldots q_p)$ comprising the steps of:

(a) producing (100) intermediate-images (I_1, P) from selected projections $(q_1 \ldots q_p)$;

(b) performing digital image coordinate transformations (102) on selected intermediate-images (I_1, P), the parameters of coordinate transformations being chosen to account for view-angles of the projections from which the intermediate images have been produced, and for the Fourier characteristics of the intermediate-images;

(c) aggregating subsets of the transformed intermediate-images (104) produced in step (b) to produce aggregate intermediate-images $(I_2, P/2)$; and

(d) repeating steps (b), and (c) in a recursive manner until all of the projections and intermediate images have been processed and aggregated to form the pixel image $\hat{f}$;

wherein the coordinate transformation parameters are chosen so that the aggregates of the intermediate-images (104) may be represented with desirable accuracy by sparse samples.

2. The method in claim 1, in which said aggregation (104, 108) is performed by adding digital images.

3. The method in claim 1, wherein at least some intermediate images (I_n, m) are produced in step (a) by backprojecting selected projections $(q_1 \ldots q_p)$.

4. The method of claim 1 wherein at least some intermediate images (I_n, m) are each formed by backprojecting two or more selected projections $(q_1 \ldots q_p)$ in step (a).

5. The method of claim 1 wherein at least some aggregate intermediate images (I_n, m) are each formed by aggregating three or more selected transformed intermediate images in step (d).

6. The method of claim 1, wherein the digital image coordinate transformations are performed using digital filtering.

7. The method of claim 1, wherein selected coordinate transformations include digital image rotations.

8. The method of claim 1, wherein selected coordinate transformations include digital image shearing (Fig. 10B, 120, 122), or shear-scaling.

9. The method (Fig. 15) of claim 1, wherein selected coordinate transformations include upsampling (101, 106) and/or downsampling (109) of the digital images.

10. The method of claim 8 in which said digital image shearing is performed by one-dimensional linear digital filters.

11. The method of claim 9 in which said digital image upsampling and/or downsampling are performed by one-dimensional linear digital filters.

12. The method of claim 10 in which at least some of said digital filters are shift-invariant.

13. The method in claim 11 in which at least some of said digital filters are shift-invariant.

14. The methods in claims 12 or 13, in which at least some of said digital filters are recursive.

15. The methods in claims 12 or 13, in which at least some of said digital filters are implemented using a fast Fourier transform (FFT).

16. The method in claim 1, in which selected oversampling is applied to selected intermediate images and/or transformed intermediate images and/or aggregate intermediate images.

17. The method in claim 1, in which non-Cartesian sampling patterns are used.

18. The method in claim 1, in which selected coordinate transformations may be combined within a level, or across adjacent levels of the hierarchy.

19. A method (Fig. 31) for creating a pixel image $\hat{f}$ from projections $(q_1 \ldots q_p)$ along a collection of lines, curves, or surfaces comprising the steps of:

(a) producing (184) intermediate images (I_l, m);

(b) performing digital image resampling on selected intermediate images (186), the location of samples being chosen to account for the view-angles of the selected projections and for the Fourier characteristics of the intermediate images,

(c) aggregating (190) selected subsets of the resampled intermediate-images to produce aggregate intermediate-images (I_z, m); and

(d) repeating steps (b) and (c) in a recursive manner, at each level of the recursion increasing the density of samples of the intermediate images, until all of the projections and intermediate images have been processed and aggregated to form the pixel image;

wherein the sampling scheme is chosen so that aggregates of the resampled intermediate-images may be represented with desirable accuracy by sparse samples.

20. The method of claim 19, wherein at least some intermediate images are produced in step (a) by weighted backprojection (Fig. 19, 180, 182) of selected projections.

21. The method of claim 19 wherein at least some intermediate images are each formed by weighted backprojection (Fig. 19, 180, 182) of two or more selected projections in step (a).

22. The method of claim 19 wherein at least some aggregate intermediate images are each formed by aggregating three or more selected transformed intermediate images in step (d).

23. The method of claim 19, in which the intermediate images have samples that lie on a family of lines, curves or surfaces.

24.The method of claim 19, in which the digital image resampling is performed by a sequence of lower-dimensional digital filtering operations by utilizing intermediate sampling schemes that lie on the intersections of the families of lines, curves or planes.

25. The method of claim 19, in which a selected degree of oversampling is applied to the selected resampled intermediate images, and aggregated intermediate images.

26. The method in claim 19, in which said aggregation is performed by adding digital images.

27. The method in claim 19, in which the resampling and aggregation may be combined across successive levels.

28. The method of claim 30, in which at least one intermediate image is weighted before and after resampling step (b) are included.

29. The method of claim 19, in which changes in sampling density are accomplished by digital filtering.

30. A method (Fig. 18) for creating a pixel image $\hat{f}$ from projections $(q_1 \ldots q_p)$ comprising the steps of:

(a) producing (99) a plurality of intermediate-images (I_l, m), with at least one corresponding to a non-Cartesian and/or non-periodic sampling pattern;

(b) performing digital image upsampling or downsampling (106) on selected intermediate-images;

(c) performing digital image coordinate transformations on upsampled/downsampled intermediate-images;

(d) aggregating (110) subsets of the transformed intermediate-images produced in step (c) to produce aggregate intermediate-images; and

(e) repeating steps (b), (c) and (d) in a recursive manner until all of the projections and intermediate images have been processed and aggregated to form the pixel image;

wherein at least one of the digital image coordinate transformations is performed with a non-Cartesian and/or non-periodic sampling pattern, and the coordinate transformation parameters are chosen so that the aggregates of the intermediate-images may be represented with desirable accuracy by sparse samples.

31. The method in claim 30, in which said aggregation is performed by adding digital images.

32. The method in claim 30, wherein at least some intermediate images are produced in step (a) by backprojecting selected projections.

33. The method of claim 30 wherein at least some intermediate images are each formed by backprojecting two or more selected projections in step (a).

34. The method of claim 30 wherein at least some aggregate intermediate images are each formed by aggregating three or more selected transformed intermediate

images in step (c).

35. The method of claim 30, wherein the digital image coordinate transformations are performed using digital filtering.

36. The method of claim 30, wherein selected coordinate transformations include digital image rotations.

37. The method of claim 30 in which said digital image resampling upsampling and/or downsampling are performed by one-dimensional linear digital filters.

38. The method of claims 37 in which at least some of said digital filters are shift-invariant.

39. The method in claim 37, in which at least some of said digital filters are recursive.

40. The method in claim 38, in which at least some of said digital filters are implemented using a fast Fourier transform (FFT).

41. The method in claim 30, in which selected oversampling is applied to selected intermediate images and/or transformed intermediate images and/or aggregate intermediate images.